What is claimed is:

1. A method to compress a matrix, the method comprising:

partitioning the matrix into a set of overlapping sub-blocks $\{m_k, k = 1, \cdots, V\}$;

weighting each sub-block m_k by a weight matrix w_k to form a weighted sub-block $m_k * w_k$, where w_k has the same dimension as m_k and $*$ denotes element-by-element multiplication, wherein $m_k * w_k$ has a decomposition

$$m_k * w_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k);$$

and representing each weighted sub-block $m_k * w_k$ by a set of scalar weights $\{\sigma_i(k), i = 1, \cdots, n(k)\}$, a set of vectors $\{u_i(k), i = 1, \cdots, n(k)\}$, and a set of vectors $\{v_i(k), i = 1, \cdots, n(k)\}$, where $n(k) \le N(k)$.

2. The method as set forth in claim 1, wherein the matrix has elements $M(i, j), i = 1, \cdots, P; j = 1, \cdots, Q$ where P and Q are the number of rows and the number of columns, respectively, of the matrix, wherein the weight matrices w_k, $k = 1, \cdots, V$ are such that for any image pixel element $M(i, j)$, the sum of all weight elements in the set of weight matrices w_k, $k = 1, \cdots, V$ multiplying $M(i, j)$ when weighting each sub-block m_k by w_k is a predetermined value.

3. The method as set forth in claim 2, wherein the predetermined value is unity.

4. The method as set forth in claim 2, wherein

for each k, the decomposition

$$m_k * w_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k)$$

is the singular value decomposition of the weighted sub-block $m_k * w_k$.

5. The method as set forth in claim 4, wherein for each index k, $n(k)$ is the smallest index i for which $\sigma_{i+1}(k) < C$, where C is a positive constant, the singular values are such that $\sigma_1(k) \geq \sigma_2(k) \geq \cdots \geq \sigma_{N(k)}(k)$, and if there is no such smallest integer, then $n(k) = N(k)$.

6. The method as set forth in claim 1, wherein

for each k, the decomposition

$$m_k * w_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k)$$

is the singular value decomposition of the weighted sub-block $m_k * w_k$.

7. The method as set forth in claim 6, wherein for each index k, $n(k)$ is the smallest index i for which $\sigma_{i+1}(k) < C$, where C is a positive constant, the singular values are such that $\sigma_1(k) \geq \sigma_2(k) \geq \cdots \geq \sigma_{N(k)}(k)$, and if there is no such smallest integer, then $n(k) = N(k)$.

8. The method as set forth in claim 6, wherein there is at least one k for which $n(k) < N(k)$.

9. The method as set forth in claim 6, wherein $n(k) = \min\{C, N(k)\}$, where C is independent of k.

10. An article of manufacture comprising a computer readable medium, the computer readable medium comprising instructions to cause a computer system to:

partition a matrix into a set of overlapping sub-blocks $\{m_k, k = 1, \cdots, V\}$;

weight each sub-block m_k by a weight matrix w_k to form a weighted sub-block $m_k * w_k$, where w_k has the same dimension as m_k and $*$ denotes element-by-element multiplication, wherein $m_k * w_k$ has a decomposition

$$m_k * w_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k);$$

and represent each weighted sub-block $m_k * w_k$ by a set of scalar weights $\{\sigma_i(k), i = 1, \cdots, n(k)\}$, a set of vectors $\{u_i(k), i = 1, \cdots, n(k)\}$, and a set of vectors $\{v_i(k), i = 1, \cdots, n(k)\}$, where $n(k) \le N(k)$.

11. The method as set forth in claim 10, wherein the matrix has elements $M(i, j), i = 1, \cdots, P; j = 1, \cdots, Q$ where P and Q are the number of rows and the number of columns, respectively, of the matrix, wherein the weight matrices w_k, $k = 1, \cdots, V$ are such that for any image pixel element $M(i, j)$, the sum of all weight elements in the set

of weight matrices w_k, $k = 1, \cdots, V$ multiplying $M(i, j)$ when weighting each sub-block m_k by w_k is a predetermined value.

12. The method as set forth in claim 11, wherein the predetermined value is unity.

13. The method as set forth in claim 11, wherein

for each k, the decomposition

$$m_k * w_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k)$$

is the singular value decomposition of the weighted sub-block $m_k * w_k$.

14. The method as set forth in claim 13, wherein for each index k, $n(k)$ is the smallest index i for which $\sigma_{i+1}(k) < C$, where C is a positive constant, the singular values are such that $\sigma_1(k) \geq \sigma_2(k) \geq \cdots \geq \sigma_{N(k)}(k)$, and if there is no such smallest integer, then $n(k) = N(k)$.

15. The article of manufacture as set forth in claim 10, wherein

for each k, the decomposition

$$m_k * w_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k)$$

is the singular value decomposition of the weighted sub-block $m_k * w_k$.

16. The article of manufacture as set forth in claim 15, wherein for each index k, $n(k)$ is the smallest index i for which $\sigma_{i+1}(k) < C$, where C is a positive constant, the singular values are such that $\sigma_1(k) \geq \sigma_2(k) \geq \cdots \geq \sigma_{N(k)}(k)$, and if there is no such smallest integer, then $n(k) = N(k)$.

17. The article of manufacture as set forth in claim 15, wherein there is at least one k for which $n(k) < N(k)$.

18. The article of manufacture as set forth in claim 15, wherein $n(k) = \min\{C, N(k)\}$, where C is independent of k.

19. A method to compress a matrix, the method comprising:

partitioning the matrix into a set of overlapping sub-blocks $\{m_k, k = 1, \cdots, V\}$, where each m_k has a decomposition

$$m_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k);$$

and representing each sub-block m_k by a set of scalar weights $\{\sigma_i(k), i = 1, \cdots, n(k)\}$, a set of vectors $\{u_i(k), i = 1, \cdots, n(k)\}$, and a set of vectors $\{v_i(k), i = 1, \cdots, n(k)\}$, where $n(k) \leq N(k)$.

20. The method as set forth in claim 19, wherein

for each k, the decomposition

$$m_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k)$$

is the singular value decomposition of the sub-block m_k.

21. The method as set forth in claim 20, wherein for each index k, $n(k)$ is the smallest index i for which $\sigma_{i+1}(k) < C$, where C is a positive constant, the singular values are such that $\sigma_1(k) \geq \sigma_2(k) \geq \cdots \geq \sigma_{N(k)}(k)$, and if there is no such smallest integer, then $n(k) = N(k)$.

22. The method as set forth in claim 20, wherein there is at least one k for which $n(k) < N(k)$.

23. The method as set forth in claim 20, wherein $n(k) = \min\{C, N(k)\}$, where C is independent of k.

24. An article of manufacture comprising a computer readable medium, the computer readable medium comprising instructions to cause a computer system to:

partition a matrix into a set of overlapping sub-blocks $\{m_k, k = 1, \cdots, V\}$, wherein m_k has a decomposition

$$m_{ki} = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k);$$

and represent each sub-block m_k by a set of scalar weights $\{\sigma_i(k), i = 1, \cdots, n(k)\}$, a set of vectors $\{u_i(k), i = 1, \cdots, n(k)\}$, and a set of vectors $\{v_i(k), k = 1, \cdots, n(k)\}$, where $n(k) \leq N(k)$.

25. The article of manufacture as set forth in claim 24, wherein

for each k, the decomposition

$$m_k = \sum_{i=1}^{N(k)} \sigma_i(k) u_i(k) v_i'(k)$$

is the singular value decomposition of the sub-block m_k.

26. The article of manufacture as set forth in claim 25, wherein for each index k, $n(k)$ is the smallest index i for which $\sigma_{i+1}(k) < C$, where C is a positive constant, the singular values are such that $\sigma_1(k) \geq \sigma_2(k) \geq \cdots \geq \sigma_{N(k)}(k)$, and if there is no such smallest integer, then $n(k) = N(k)$.

27. The article of manufacture as set forth in claim 25, wherein there is at least one k for which $n(k) < N(k)$.

28. The article of manufacture as set forth in claim 25, wherein $n(k) = \min\{C, N(k)\}$, where C is independent of k.

29. A method to synthesize a matrix $\hat{M}$, the method comprising:

receiving families of sets comprising:

a family of sets of scalar weights $\{\{\sigma_i(k), i=1,\cdots,n(k)\}, k=1,\cdots,V\}$;

a family of sets of vectors $\{\{u_i(k), i=1,\cdots,n(k)\}, k=1,\cdots,V\}$; and

a family of sets of vectors $\{\{v_i(k), i=1,\cdots,n(k)\}, k=1,\cdots,V\}$;

forming weighted vector outer products and summing to provide $\hat{m}_k, k=1,\cdots,V$ where

$$\hat{m}_k = \sum_{i=1}^{n(k)} \sigma_i(k) u_i(k) v_i'(k);$$

and overlaying $\hat{m}_k$ for $k=1,\cdots,V$ and summing to provide the synthesized matrix $\hat{M}$.

30. An article of manufacture comprising a readable computer medium, the readable computer medium comprising instructions to cause a computer system to synthesize a matrix $\hat{M}$ by

receiving families of sets comprising:

a family of sets of scalar weights $\{\{\sigma_i(k), i=1,\cdots,n(k)\}, k=1,\cdots,V\}$;

a family of sets of vectors $\{\{u_i(k), i=1,\cdots,n(k)\}, k=1,\cdots,V\}$; and

a family of sets of vectors $\{\{v_i(k), i=1,\cdots,n(k)\}, k=1,\cdots,V\}$;

forming weighted vector outer products and summing to provide $\hat{m}_k, k=1,\cdots,V$ where

$$\hat{m}_k = \sum_{i=1}^{n(k)} \sigma_i(k) u_i(k) v_i'(k);$$

and overlaying $\hat{m}_k$ for $k = 1, \cdots, V$ and summing to provide the synthesized matrix $\hat{M}$.

31. A method to synthesize a matrix $\hat{M}$, the method comprising:

receiving families of sets comprising:

a family of sets of scalar weights $\{\{\sigma_i(k), i = 1, \cdots, n(k)\}, k = 1, \cdots, V\}$;

a family of sets of vectors $\{\{u_i(k), i = 1, \cdots, n(k)\}, k = 1, \cdots, V\}$; and

a family of sets of vectors $\{\{v_i(k), i = 1, \cdots, n(k)\}, k = 1, \cdots, V\}$;

forming weighted vector outer products and summing to provide $\hat{m}_k, k = 1, \cdots, V$ where

$$\hat{m}_k = \sum_{i=1}^{n(k)} \sigma_i(k) u_i(k) v_i'(k);$$

weighting each $\hat{m}_k$ by a weight matrix w_k to form $\hat{m}_k * w_k$ where $*$ denotes element-by-element multiplication; and

overlaying $\hat{m}_k * w_k$ for $k = 1, \cdots, V$ and summing to provide the synthesized matrix $\hat{M}$.

32. An article of manufacture comprising a computer readable medium, the computer readable medium comprising instructions to cause a computer system to synthesize a matrix $\hat{M}$ by

receiving families of sets comprising:

a family of sets of scalar weights $\{\{\sigma_i(k), i = 1, \cdots, n(k)\}, k = 1, \cdots, V\}$;

a family of sets of vectors $\{\{u_i(k), i = 1, \cdots, n(k)\}, k = 1, \cdots, V\}$; and

a family of sets of vectors $\{\{v_i(k), i = 1, \cdots, n(k)\}, k = 1, \cdots, V\}$;

forming weighted vector outer products and summing to provide $\hat{m}_k, k = 1, \cdots, V$ where

$$\hat{m}_k = \sum_{i=1}^{n(k)} \sigma_i(k) u_i(k) v_i'(k);$$

weighting each $\hat{m}_k$ by a weight matrix w_k to form $\hat{m}_k * w_k$ where $*$ denotes element-by-element multiplication; and

overlaying $\hat{m}_k * w_k$ for $k = 1, \cdots, V$ and summing to provide the synthesized matrix $\hat{M}$.